Will eliminating deer help stop the spread of infected ticks?

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Over the years, there has been much discussion and debate over whether reducing the deer population would in turn help lower the risk of Lyme disease, particularly in endemic regions. A 2014 study found that reducing the deer population "dramatically reduced *I. scapularis* abundance and Lyme disease cases on a Connecticut peninsula." [1] A study conducted 2 years later, however, found that deer reduction was not effective in controlling *I. scapularis* in non-insular areas.

In an effort to determine the efficacy of various tick management approaches, including deer reduction, investigators from the Center for Vector Biology & Zoonotic Diseases at The Connecticut Agricultural Experiment Station in Connecticut conducted a 3-year study in Redding, Connecticut – a town endemic for Lyme disease. Four residential neighborhoods were included in the study, which took place between January 2013 and September 2015. [2]

The authors found that reducing the number of deer did not have a significant impact. Deer reduction alone only reduced the number of *I. scapularis* ticks on white-footed mice by 3%. Interestingly, the deer reduction strategy forced the *I. scapularis* tick to feed on other hosts, and the percentage of ticks infected with *B. burgdorferi* actually increased.

In contrast, a combination of broadcast application of Metarhizium anisopliae (an entomopathogenic fungus) and the distribution of fipronil-based rodent-targeted bait boxes resulted in a 94% reduction in larval *I. scapularis* parasitizing white-foot mice that tested positive for *B. burgdorferi*, respectively.

What went wrong with the deer reduction tactic?

The authors planned on reducing the deer population to below 4.0 deer/km2 using professional sharpshooters. "Deer were concentrated with bait on cooperating homeowners' properties and euthanized with a single 0.223 caliber bullet to the center of the brain, consistent with American Veterinary Medical Association and Sikes and Gannon (2011) standards for humane euthanasia and in compliance with The Connecticut Agricultural Experiment Station's Institutional Animal Care and Use Committee (#P18-13) and Connecticut Department of Energy and Environmental Protection's Volunteer Authorization (#1315006b)," writes Williams.

"Deer were removed from January-March of each year, largely after the end of the regulated hunting season," added Williams.

However, investigators fell far short of their desired goal for 4.0 deer/km2. The deer population was reduced to not much below 17 deer/km2. "Due to hunter interference and resulting safety concerns, we were forced to suspend deer removal efforts prematurely and did not achieve target densities," explains

Williams.

What are the problems with the combination of M. anisopliae/fipronil-based bait boxes?

A previous study found bait boxes had limited success. According to Williams, for larger properties with a high abundance of white-footed mice, bait boxes were effective in eliminating nymphal *I. scapularis* and reducing *B. burgdorferi* infection in white-footed mice by 53%.

In this study, the combination of M. anisopliae/fipronil-based bait boxes reduced the population of *I. scapularis* ticks on white-footed mice, "but not to levels sufficient to interrupt the *B. burgdorferi* pathogen transmission cycle," writes Williams.

The authors suggest that placing more bait boxes on larger, individual properties might be more effective. But at a higher cost. "A second ring of bait boxes would likely have broken the transmission cycle, but at $40/installed box, this strategy would likely be cost prohibitive to most homeowners (?$1,000/season)." [2]

The combination of M. anisopliae/fipronil-based bait boxes could, however, be effective for localized relief, the authors conclude. Meanwhile, deer reduction alone would only be effective if communities could commit to a deer population below 5.0 deer/km2.

What is entomopathogenic fungi?

Scientists have been introducing alternatives for synthetic chemicals to control ticks. "Natural product-based acaricides or entomopathogenic fungi have emerged as alternatives to kill host-seeking ticks for homeowners who are unwilling to use synthetic chemical acaricides," writes Eisen, from the Division of Vector-Borne Diseases, CDC in the *Journal of Medical Entomology*. [3] He adds, "However, as compared with synthetic chemical acaricides, these approaches appear less robust in terms of both their killing efficacy and persistence."

What is fipronil?

Fipronil in a bait box allows the use of an acaricide without raising the same level of environmental concerns for a homeowner. "Fipronil belongs to the phenylpyrazole family and has acaricidal and insecticidal properties," writes Bonneau from Virbac, France, in the journal *Parasites and Vectors*. [4] "Fipronil's putative mode of insecticidal action is interference with the passage of chloride ions through the gamma- aminobutyric acid (GABA)-regulated chloride ion channel, which results in uncontrolled central nervous system activity and subsequent death of the insect."

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